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Removal Action Workplan

39-Unit Apartments
Western One-Third of Installation Restoration Site 02
Former Fleet and Industrial Supply Center Oakland
Alameda Facility/Alameda Annex
Alameda, California

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Prepared for:

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LIST OF ABBREVIATIONS AND ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
AST	aboveground storage tank
BAAQMD	Bay Area Air Quality Management District
bgs	below ground surface
CE	chloroethene
CIC	Community Improvement Commission
cis-1,2-DCE	cis-1,2-dichloroethene
cy	cubic yards
DTSC	Department of Toxic Substances Control
EIR	Environmental Impact Report
ERRG	Environmental Remediation and Resources Group
ESL	Environmental Screening Level
FISCA	Fleet and Industrial Supply Center Oakland, Alameda Facility/ Alameda Annex
HDPE	high-density polyethylene
HI	Hazard Index
IR02	Installation Restoration Site 02
µg/kg	microgram per kilogram
µg/l	microgram per liter
$\mu g/m^3$	microgram per cubic meter
mg/l	milligram per liter
msl	mean sea level
NAS	Naval Air Station
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
OSHA	Occupational Safety and Health Administration
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PPE	personal protective equipment
RAP/ROD	Remedial Action Plan/Record of Decision
RAO	Removal Action Objectives
RAW	Removal Action Workplan
RCD	Resources for Community Development
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Action Plan/Feasibility Study
RWQCB	Regional Water Quality Control Board
SSDS	sub-slab depressurization system
1,1,1-TCA	1,1,1-trichloroethane
TCE	trichloroethene
TDS	total dissolved solids
TPH	total petroleum hydrocarbon
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

DEPARTMENT OF TOXIC SUBSTANCES CONTROL APPROVAL

This Removal Action Workplan selects Alternative 3 (i.e., Construction of a Passive Sub-slab Depressurization System for New Buildings) as the removal action for the western one-third of Installation Restoration Site 02 at the former Fleet and Industrial Supply Center Oakland, Alameda Facility/Alameda Annex, in Alameda, California. The selected removal action is protective of human health and the environment. Implementation of the selected removal action would address existing environmental conditions sufficient for the Department of Toxic Substances Control to modify an interim covenant that restricts use of the property to allow near-term residential development at the project area. The Department of Toxic Substances Control will require appropriate institutional controls as a long-term remedy in a basewide cleanup decision. Pursuant to the California Health and Safety Code, section 25356.1, the Department of Toxic Substances Control hereby approves this Removal Action Workplan.

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Anthony J. Landis, P.E. Date
Chief, Northern California Operations
Office of Military Facilities
Department of Toxic Substances Control
California Environmental Protection Agency

EXECUTIVE SUMMARY

Northgate Environmental Management, Inc. (Northgate) has prepared this Removal Action Workplan (RAW) on behalf of the California Department of Toxic Substances Control (DTSC) and Resources for Community Development (RCD). RCD proposes to construct 39 residential units in three multi-family buildings (the 39-Unit Apartments) on a site located on the western one-third of Installation Restoration Site 02 (the Site), which is a portion of the former Fleet and Industrial Supply Center Oakland, Alameda Facility/Alameda Annex (FISCA) in Alameda, California. The purpose of the RAW is to provide a plan to address existing environmental conditions sufficient for DTSC to modify an interim covenant that restricts use of the property to allow residential development at the Site. The Site consists of an approximate 2.5-acre parcel of relatively level vacant land at the western end of Installation Restoration Site 02, which is bounded by the College of Alameda to the southeast, a residential development to the south, and Coast Guard housing to the north and west. Ground surface elevations range from 10 to 15 feet above mean sea level (msl). The RAW evaluates the implementability, effectiveness, and cost of three removal action alternatives designed to mitigate the potential for volatile organic compound (VOC) soil vapor intruding into building interiors. The removal action alternatives are:

- Alternative 1: No Action
- Alternative 2: Construction of an Active Sub-slab Depressurization System for New Buildings
- Alternative 3: Construction of a Passive Sub-slab Depressurization System for New Buildings

Based on a comparative analysis, Alternative 3, construction of a passive sub-slab depressurization system for new buildings, is the recommended alternative for mitigating potential impacts to indoor air within the proposed residential buildings.

The mitigation alternative consists of constructing a soil gas collection blanket and piping system under the proposed floor slabs that will be connected to wind turbines on the roofs to draw fresh air and soil gas, if present, from beneath the buildings to the roofs. Inlet pipes will be installed from the roofs to a sub-slab gas collection blanket, and a membrane will be installed below the gas collection blanket to reduce the potential for drawing soil gas from the ground beneath the building and the surrounding area. In addition, a gas barrier is proposed as part of the floor slab to reduce the potential for soil gas to move through the floor slab into the residential units. The barrier would be constructed of high-density polyethylene (HDPE). This is protective of potential risks to human health, and complies with existing regulatory criteria, while allowing full use of the Site for the intended development.

1.0 INTRODUCTION

This Removal Action Workplan (RAW) has been prepared by Northgate Environmental Management, Inc. (Northgate) on behalf of Resources for Community Development (RCD) and the California Department of Toxic Substances Control (DTSC). RCD is proposing to construct 39 residential units in three 2-story multi-family buildings on a site located on the western one-third of Installation Restoration Site 02 (Site), which is a portion of the former Fleet and Industrial Supply Center Oakland, Alameda Facility/Alameda Annex (FISCA) in Alameda, California. A site location map is shown on Figure 1.

DTSC and the U.S. Navy (Navy) signed the *Interim Covenant to Restrict Use of Property, Environmental Restriction* (Covenant), dated July 17, 2000. The Covenant states that Installation Restoration Site 02 (IR02) shall not be used for residential purposes, and construction activities shall not begin until DTSC determines that soils having polychlorinated biphenyls (PCBs) and cadmium concentrations above cleanup goals have been properly remediated and a release terminating these restrictions has been recorded by DTSC.

DTSC issued a letter on February 27, 2004 concurring that the U.S. Navy completed remediation of PCBs and cadmium contamination in soil at IR02 pursuant to the Remedial Action Plan/Record of Decision (RAP/ROD), which DTSC approved on June 26, 2001. The RAP/ROD specifies cleanup of soil in the western one-third of IR02 to a level allowing unrestricted residential use, including home vegetable gardening. DTSC's letter also notes that the final decision on residential use of the western one-third portion of IR02 will depend on the results of the ongoing groundwater investigation and adequate remediation of a benzene/naphthalene plume that underlies the Site and adjacent areas.

Since remediation of the groundwater plume has not been conducted, and in keeping with the affordable housing construction schedule, the City of Alameda submitted a *Vapor Migration Plan* (December 2003) for a sub-slab depressurization system (SSDS) (West, 2003). The function of the SSDS would be to capture and vent any vapor from soil and groundwater from beneath the proposed residential buildings. The SSDS will serve to protect public health and the environment until such time as the final remedy for the entire benzene/naphthalene plume is completed. DTSC provided comments on the *Vapor Migration Plan* in a letter dated March 15, 2004. The intent of this RAW is to modify the proposed West SSDS design, as appropriate, based on DTSC comments, and to prepare a RAW document that meets the requirements of DTSC. In addition, the SSDS will serve to meet the requirements of Mitigation Measure HAZ-6 of the environmental impact report (EIR) prepared by Catellus (*Mixed Use Development EIR, City of Alameda* [SCH# 1998112078], May 2000) and the November 19, 2001 *Addendum to the EIR*, which describes the project and environmental issues; summarizes the *Health Risk Assessment* prepared by Environmental Resources

Management; and addresses potential exposure of the public to soil gases in enclosed building spaces.

The property is currently owned by the Community Improvement Commission (CIC), a public body that is a separate legal entity from the City of Alameda. The City Council acts as the governing board of both legal entities.

The CIC and the Housing Authority of the City of Alameda have selected RCD, a locally-based nonprofit housing developer, to develop the 39-unit project. The CIC intends to quit-claim the property to the Housing Authority of the City of Alameda, at which time the City Council, acting as the Board of Commissioners of the Housing Authority, intends to enter into a long-term ground lease with RCD.

The proposed residential development is referred to as the “39-Unit Apartments” or “39-Unit Affordable Housing” project. Preliminary plans include apartment buildings surrounding a courtyard with a separate teen recreation center and a raised-bed vegetable garden in the courtyard (see Figure 2). The buildings will be supported on a shallow foundation system with a concrete slab-on-grade.

The RAW identifies, evaluates, and recommends interim measures for elevated concentrations of volatile organic compounds (VOCs) in groundwater that may volatilize and migrate through shallow soils located under the Site. Under this situation, VOCs may enter and collect in enclosed building spaces. Selection of the mitigation alternative is based on an analysis of the effectiveness, implementability, and cost of several alternatives. The primary objective of the RAW is to develop and recommend a remedy that will mitigate potential soil gas migration containing VOCs to indoor air and, therefore, will be protective of human health by elimination of a potential exposure pathway.

The Record of Decision (ROD) for remediation of the benzene/naphthalene groundwater plume is scheduled for final approval in February 2007. The selected remedy for the benzene/naphthalene plume is intended to be protective of public health, including for residential land uses. (Navy, 2006) The ROD is expected to include institutional controls comparable to the alternative selected in this RAW to allow residential land use within the footprint of the benzene/naphthalene groundwater plume until groundwater remedial goals have been achieved. Thus, this RAW selects interim measures permitting near-term residential use of the Site. DTSC will require appropriate institutional controls as a long-term remedy in a basewide cleanup decision.

2.0 SITE SETTING

2.1 Site Location

The Site, as shown on the site location map (Figure 1), consists of an approximate 2.5-acre parcel of vacant land located at the western end of IR02 within the former FISCA site. Appendix A is the legal description of the Site. The property is owned by the CIC. The Site is bounded on the west and north by residential developments and a residential development project is currently under construction to the south of the Site. The property to the east is currently vacant. The Site will be bounded on the south by Wilver "Willie" Stargell Avenue (formerly Tinker Avenue).
A commercial area exists approximately 1,000 feet to the east. The entrance to the Posey Tunnel between Oakland and Alameda is approximately 1,400 feet to the east of the Site. The Oakland Inner Harbor is approximately 2,500 feet north of the Site.

The Site consists of relatively level, vacant land. The Site appears to have been compacted and leveled.

Ground surface elevations range from approximately 10 to 15 feet above msl. Surface water flow is most likely to the south.

2.2 Historical Site and Vicinity Use and Site Ownership

2.2.1 Historical Surrounding Land Use

Previously existing marshland and tidal areas in the vicinity of the Site were filled between 1900 and 1939. These materials were dredged from the San Francisco Bay, the Oakland Inner Channel, and former tidal areas (Tetra Tech, 1998b). Prior to the 1920s, land south of the Site was primarily used for residential uses, while areas to the north of the Site were marshlands and tidal flats along the Oakland Inner Channel.

From the 1880s to the 1900s, major industrial facilities, including the Pacific Coast Oil Works refinery, two manufactured gas plants, and several other manufacturing businesses, operated within 1 mile of the Site (PRC, 1996). From 1884 to 1941, the Southern Pacific Railroad operated shipyards along the Oakland Inner Channel to the north and west of the Site (PRC, 1996). In 1928 and 1929, the San Francisco Bay Area Airdrome (Airdrome), an airline passenger facility, was constructed on-Site and operated until 1941. In the 1950s, the U.S. Navy purchased the area of the Site and converted the Site area into a screening and scrap yard.

Todd Shipyard Corporation operated along the Alameda shore of the Oakland Inner Channel from 1947 to 1952 (PRC, 1996). Between 1930 and the 1990s, the U.S. Navy purchased and operated the Naval Air Station (NAS) Alameda in the area to the west, north, and south of the Site (PRC, 1996). The former NAS Alameda is currently utilized for residential, commercial, and light industrial uses.

The College of Alameda is present to the southeast of the Site. The Oakland Inner Channel lies north of the Site and is presently used for maritime traffic and small vessel storage. Land to the north of the Oakland Inner Channel is used for light industrial, commercial, and residential purposes.

2.2.2 Historical Site Uses

Prior to the 1920s, the Site and its surrounding areas existed as undeveloped marshlands and tidal flats along the northern shore of the island of Alameda. Between 1925 and 1927, the area presently occupied by the Site was filled with materials dredged from the San Francisco Bay, the Oakland Inner Channel, and other, unknown sources (PRC, 1996; Tetra Tech, 1998b).

Between the 1930s and 1941, the Site was part of the Airdrome, which included a 2,500-foot soil and crushed shell runway, an aircraft maintenance hangar, and a passenger terminal. The Airdrome was operated by several commercial airlines housed in former Building 365 east of the Site. Aircraft maintenance activities were conducted adjacent to former Building 365 (Figure 1-2; ERM, 1987).

In 1941, the U.S. Navy purchased the Site. In the early 1950s, the Site was converted to a material screening lot and scrap yard for FISCA, a satellite supply depot to the main Fleet and Industrial Supply Center in Oakland. From the 1950s until the 1990s, the Site was part of a scrap yard and storage facility for the United States Department of Defense’s Reutilization and Marketing Office, the Fleet Hospital Support Office, and other tenants. Facilities at the Site included a storage area on the northern portion of the parcel and a scrap bin along the southern boundary. Railroad tracks ran along the southern boundary of the Site. Materials stored at the Site included automobiles, transformers, capacitors, metal scrap, and structural waste including asbestos insulating materials (ERM, 1987; PRC, 1996). A review of the 1973 aerial photograph revealed aboveground storage tanks (ASTs) and sumps located approximately 500 feet to the east of the Site (ERM, 1987). Scrap yard activities ceased in the 1990s due to closure of FISCA.

The Navy transferred the FISCA property to the City of Alameda in July 2000. The Navy is continuing to evaluate environmental conditions and perform environmental cleanup activities elsewhere on the FISCA site.

2.3 Geology

The Site is located on a geologically depressed area defined by the San Andreas and Hayward faults. Subsurface lithology includes artificial fill and marine and fluvial sedimentary formations. The artificial fill, found within the uppermost 10 to 20 feet, contains dredged material overlying the sedimentary formations. The sedimentary formations, consisting of Bay Mud, Merritt Sand, Posey Formation, and Yerba Buena Mud, are located from the base of the fill to approximately 150 feet below ground surface (bgs).

Fill materials are present within the uppermost 10 to 20 feet bgs at the Site. The fill material is heterogeneous in nature, ranging from course-grained materials including sand to fine-grained materials with silts and clays.

Bay Mud is present underlying the fill materials at the Site and consists of highly plastic silty clays and clayey silts, sometimes with discontinuous sand and organic peat lenses. The thickness of the Bay Mud at the Site ranges from approximately 10 to 95 feet (PRC, 1996). A discontinuous layer (generally less than 1 foot thick) of organic peat (marsh crust) is present at the interface of the artificial fill with the Bay Mud, between 10 and 20 feet bgs (Tetra Tech, 2000). The Merritt Sand of the Posey Formation underlies the Bay Mud and consists of well-sorted clayey sands to fine-grained sands, ranging in thickness between 60 feet to 90 feet. The Yerba Buena Mud underlies the Merritt Sand. The Yerba Buena Mud consists of plastic clays with occasional silts, clayey silts, and sand lenses.

2.4 Hydrogeology

Groundwater is found within the fill materials and the Merritt Sand. Groundwater within the fill materials is unconfined, and elevations measured in the fill materials range between 1.65 and 5.98 feet above msl (PRC, 1996; Tetra Tech, 1998a). Groundwater flow within the fill materials is west-northwest with a gradient between 0.0017 and 0.008 feet per foot (PRC, 1996). Based on a survey performed in 1992 by PRC, the Site surface elevation ranged from 11.9 to 13.6 feet above msl. This places the groundwater at an approximate average depth of 9 feet bgs.

Groundwater within the Merritt Sand is considered a regional aquifer. Recharge of the Merritt Sand aquifer is mainly by lateral flow from upgradient areas, and it is believed to discharge through lateral groundwater flow to the San Francisco Bay, Oakland Inner Harbor, and the Seaplane Lagoon (EERG, 2004). Groundwater elevations of the piezometric surface in the Merritt Sand aquifer were measured between 5.45 and 3.96 feet above msl (Tetra Tech, 1998a).

3.0 SITE INVESTIGATIONS

Site investigations and remedial activities were conducted at the Site and surrounding areas since 1987. Investigation activities included soil gas, soil and groundwater sampling, ground-water monitoring, and surface water sampling. Based on the findings of the site investigations, remedial activities were conducted in 1995 in the vicinity of former Building 366, which included the removal of soil containing PCBs and lead. In 1998, remedial activities were conducted in the southeast section of IR02 and included removal of soil containing total petroleum hydrocarbons (TPH) and PCBs. A summary of the investigations and remedial investigations conducted at the Site and the surrounding areas is presented below.

3.1 ERM-West, 1987

In 1987, ERM-West conducted soil and shallow groundwater investigations at the Site. Soil and groundwater samples were collected and analyzed for VOCs, PCBs, polycyclic aromatic hydrocarbons (PAHs), metals, and metalloids.

Laboratory analysis of three soil samples collected between approximately 1.5 and 2.5 feet bgs revealed the following:

- Toluene up to 2 micrograms per kilogram (µg/kg); and
- Xylenes up to 1 µg/kg.

Laboratory analysis of groundwater samples revealed the following results:

- Benzene up to 51 micrograms per liter;
- Toluene up to 11 µg/l;
- Ethylbenzene up to 18 µg/l;
- Xylenes up to 36 µg/l;
- cis-l,2-dichloroethene (cis-1,2-DCE) up to 0.4 µg/l; and
- Chloroethene (CE) up to 2.7 µg/l (sample collected from shallow groundwater monitoring well MW-1 [ERM, 1987]).

3.2 PRC, 1992 to 1994

Between 1992 and 1994, PRC conducted remedial investigation activities at several FISCA locations. Remedial investigation activities performed at the Site included the collection of soil gas, soil, and groundwater samples. Groundwater hydrogeologic slug testing was also conducted using the shallow groundwater monitoring wells at the Site (PRC, 1996).

In 1993, 214 soil gas samples were collected within IR02 based on a 50-foot grid spacing. The soil gas samples were analyzed for VOCs. Laboratory analysis of the soil gas samples revealed the following results for samples collected at approximately 2 to 6 feet bgs:

- Benzene up to 17,000 micrograms per cubic meter ($\mu g/m^3$);
- Toluene up to 7,000 $\mu g/m^3$;
- Xylenes up to 400 $\mu g/m^3$;
- Tetrachloroethene (PCE) up to 330,000 $\mu g/m^3$;
- Trichloroethene (TCE) up to 2,000 $\mu g/m^3$;
- 1,1,1-trichloroethane (1,1,1-TCA) up to 800 µg/m; and
- Total volatile hydrocarbons up to 20,000,000 $\mu g/m^3$.

Between September 1992 and March 1994, 50 soil samples were collected at the Site and analyzed for VOCs. Laboratory analysis revealed the following results for soil samples collected from between 9 and 65 feet bgs (PRC, 1996):

- Benzene up to 10,000 µg/kg (S43);
- Toluene up to 5,500 µg/kg (S43);
- Ethylbenzene up to 33 µg/kg (S43);
- Xylenes up to 33,000 µg/kg (S43);
- Acetone up to 140 µg/kg (S25);
- Carbon disulfide up to 49 µg/kg (A71); and
- 2-butanone up to 21 µg/kg (A71).

Between 1992 and 1994, nine shallow groundwater samples were collected at the Site and analyzed for VOCs. Laboratory analysis of the shallow groundwater samples collected from between 9 and 65 feet bgs revealed the following results (PRC, 1996):

- Benzene up to 160 µg/l (S43);
- Toluene up to 35 µg/l (S25);
- Ethylbenzene up to 26 µg/l (S25);
- Xylenes up to 53 µg/l (S25);
- Styrene up to 7 µg/l (S12); and
- Chloroform up to 0.6 µg/l (S25).

3.3 Tetra Tech, 1994 to 1996

Between 1994 and 1996, Tetra Tech conducted nine groundwater monitoring events at the Site. Groundwater samples were collected from seven shallow groundwater wells (PW-14, S04, S12, S15, S24, S25 and S43) and the deep groundwater well (D04) installed on-Site. The groundwater samples collected during the monitoring events were ana1yzed for TPH, VOCs, PAHs, pesticides, PCBs, metals, metalloids, total dissolved solids (TDS), nitrates, and sulfates (Tetra Tech, 1998).

Laboratory analysis of shallow groundwater samples collected between 1992 and 1996 from the seven on-site shallow groundwater wells revealed the following results:

- Benzene up to 280 µg/l (S25);
- Toluene up to 62 µg/l (S25);
- Ethylbenzene up to 72 µg/l (S43);
- Xylenes up to 98 µg/l (S25);
- Styrene up to 7 µg/l (S12);
- Chloroform up to 0.6 µg/l (S25);
- cis-1,2-DCE up to 0.2 µg/l (PW-l4); and
- CE up to 0.2 µg/l (PW-14).

Laboratory analysis of groundwater samples collected from the deep groundwater monitoring well located at the southwest corner of the Site revealed TPH up to 1.34 milligrams per liter (mg/l). Laboratory analysis of deep groundwater samples did not reveal VOCs above their respective laboratory reporting limits of 0.1 µg/l.

Laboratory analysis of groundwater samples collected from 20 shallow groundwater monitoring wells installed east of the Site revealed the following results (Tetra Tech, 1998):

- Benzene up to 1,400 µg/l;
- Toluene up to 120 µg/l;
- Ethylbenzene up 76 µg/l; and
- Xylenes up to 130 µg/l.

3.4 Tetra Tech, 1999

In 1999, Tetra Tech conducted a soil gas investigation at the Site and other portions of IR02. Tetra Tech collected 40 soil gas samples at the Site and 125 samples on the remaining portions of IR02 using a 50-foot grid spacing. Laboratory analysis of the soil gas samples collected indicated benzene concentrations up to 50 $\mu g/m^3$ in the sample from location E3. Laboratory analysis of the soil gas samples collected on the remaining portion of IR02 revealed benzene up to 17,000$\mu g/m^3$ in the sample collected from H1, adjacent to the eastern boundary of the Site (Tetra Tech, 2000).

3.5 ERM, 2001

In March 2001, ERM conducted soil gas and groundwater investigations at the Site. Five soil gas and four groundwater samples were collected and analyzed for VOCs. Soil gas samples were collected in Tedlar bags and analyzed for VOCs by United States Environmental Protection Agency (USEPA) Method TO-14. Laboratory analysis of the soil gas samples collected from 4 feet bgs revealed the following results:

- Benzene up to 2.4 µg/m3 (SG-4);
- Toluene up to 22 µg/m3 (SG-1);
- Ethylbenzene up to 7.6 µg/m3 (SG-l);
- Xylenes up to 33.7 µg/m3 (SG-l);
- Trichlorotrifluoroethane up to 2.2 µg/m3 (SG-4);
- Methylene chloride up to 4.6 µg/m3 (SG-4);
- PCE up to 9.7 µg/m3 (SG-4); and
- 1,2,4-trimethylbenzene up to 2.3 µg/m^3 (SG-l).

Laboratory analysis of the groundwater samples collected between 10 and 20 feet bgs revealed the following results (ERM, 2002):

- Benzene up to 480 µg/l (HP-2-20);
- Toluene up to 170 µg/l (HP-3-20);
- Ethylbenzene up to 230 µg/l (HP-3-20); and
- Xylenes up to 410 µg/l (HP-3-20).

3.6 Tetra Tech, 2001

In June 2001, Tetra Tech conducted soil and groundwater investigations at the Site including the collection and analysis of three soil gas and six shallow groundwater samples for benzene (Tetra Tech, 2001). Laboratory analysis of the soil gas samples revealed benzene up to15.17 µg/m^3 in OS-SG-14 at 7 feet bgs. Laboratory analysis of the groundwater samples revealed benzene up to 645 µg/l at location OS-HP-17, collected between 16 and 20 feet bgs (Tetra Tech, 2001).

Laboratory analysis of off-site groundwater samples collected from IR02 revealed benzene concentrations up to 1,970 µg/l (OS-HP-14) and 1,770 µg/l (OS-HP-37) in the samples collected adjacent to the east and west boundaries of the Site, respectively (Tetra Tech, 2001).

4.0 IDENTIFICATION OF REMOVAL ACTION GOALS, OBJECTIVES AND SCOPE

The purpose of this section is to identify the type and appropriateness of removal actions, and to identify the goals, objectives, and scope of such action that would be needed to address the risks posed by chemicals of concern in soil, groundwater, and soil gas at the Site. In addition, regulatory requirements are identified so that remediation goals can be compared to relevant standards.

4.1 Potential Chemicals of Concern

The results of previous investigations indicate the presence of various chemicals in soil, groundwater, and soil gas. The investigation results for soil can be summarized as follows: low detections of metals in soil, widespread detections of PAHs, and occasional detections of TPH. Shallow groundwater was found to contain VOCs and several metals. Soil gas samples have detected VOCs, as well as TPH-related constituents. Risk assessments have been performed as part of the Remedial Investigation of FISCA (PRC, 1996), and as part of other studies, including the most recent *Groundwater Remedial Investigation/Feasibility Study, Alameda Point Site 25 and Alameda Annex IR-02, Alameda, California* (RI/FS) prepared by Environmental Remediation and Resources Group (ERRG, 2004).

The risk assessment associated with the RI/FS concludes current conditions do not pose any unacceptable risks to residents, students, or workers, and ongoing groundwater monitoring has demonstrated that ecological receptors are not being exposed to contaminated groundwater from the Site. Of the pathways evaluated in the RI/FS's risk assessment, only the hypothetical groundwater ingestion scenario (use of shallow groundwater as a potable water supply) was found to have associated risks outside the USEPA's risk management range. Shallow soil at IR02 was remediated by the U.S. Navy, and the cleanup of soil was approved by DTSC in its letter dated February 27, 2004.

The results of the Navy's risk assessment specify that the risks associated with groundwater (assuming no domestic potable water use) range from 2×10^{-6} to 3×10^{-5} for the various exposure scenarios evaluated, including residential indoor air inhalation. The non-carcinogenic Hazard Index (HI) does not exceed 1. If groundwater is assumed to be used for domestic potable water,[1] the calculated risks would exceed the risk management range, due primarily to the presence of benzene and naphthalene. The RI/FS evaluates remedial alternatives designed to reduce contamination to below drinking water standards, so if the drinking water pathway were completed in the future, there would be no unacceptable risk to human health.

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1 Site groundwater cannot be used for potable water. A deed restriction (Covenant to Restrict Use of Property [Environmental Restrictions], recorded July 20, 2000) prohibits such use.

4.2 Removal Action Objectives

Because DTSC has determined that modifications should be made to the assumptions used by the Navy in it's analysis of indoor air risk, DTSC proposes a risk management decision to require engineering controls in a RAW to remove the potential indoor air intrusion pathway. DTSC is pursuing institutional controls as the final remedy to address the potential indoor air risk in a separate cleanup decision.

The goal of this removal action is to minimize or eliminate a release or threatened release that may result in an impact to human health. The overall removal action goal for the Site is to prevent exposure of future residents to elevated levels of VOCs in indoor air. Removal action objectives (RAO) were identified to achieve this goal. The objectives consider site characteristics that influence fate and transport of contaminants of concern, pathways of exposure, human receptors, associated short- and long-term human health and environmental effects, and the intended end use of the Site.

For the project, the Site will be developed for residential use in the form of a multi-family affordable housing project. The majority of the Site will be covered with three multi-family buildings.

Two potential screening guidance documents could be used to select appropriate RAO concentrations for VOCs in indoor air: 1) *Draft Subsurface Vapor Intrusion Guidance* (USEPA, 2002); and 2) *Screening for Environmental Concerns at Sites with Contaminated Soil and Groundwater*, Interim Final (San Francisco Bay Regional Water Quality Control Board [RWQCB], 2005).

The USEPA document presents a tiered screening approach, which, depending on site findings, progresses toward more complex assessments using site-specific data (USEPA, 2002). The evaluation criteria are considered "generic criteria" that reflect generally reasonable worst-case scenarios. A shallow soil gas attenuation factor of 0.1 is assumed (i.e., ratio of indoor air to soil gas measured at 5 feet or less from the base of the foundation) (USEPA, 2002). The USEPA indoor air target to meet the 10^{-6} risk level for benzene is 0.31 $\mu g/m^3$. The USEPA target for naphthalene that meets a HI of 1 is 0.03 $\mu g/m^3$.

The RWQCB Environmental Screening Level (ESL) for indoor air is 0.085 $\mu g/m^3$ for benzene and 0.071 $\mu g/m^3$ for naphthalene (RWQCB, 2005).

4.3 Potential Applicable or Relevant and Appropriate Requirements

This section identifies potential applicable or relevant and appropriate requirements (ARARs) pertinent to the identification, screening, and selection of remedial alternatives for the Site. An ARAR may either be "*applicable*" or "*relevant and appropriate*", but not both. If there is no specific federal or state ARAR for a particular chemical or removal action, or if the existing ARARs are not considered sufficiently protective, other criteria or guidelines may be considered or identified and used to protect human health and the environment. Determining whether a requirement is considered an ARAR involves consideration of the removal actions planned, the hazardous substances present, characteristics of hazardous substances, physical characteristics of the Site, and other appropriate factors. The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) identifies three types of ARARs:

- ***Chemical-specific ARARs*** are health- or risk-based concentration limits, numerical values, or methodologies for various environmental media. They are established for a specific chemical that may be present in a specific medium at a site, or that may be discharged to the site during implementation of remedial alternatives. These ARARs set limits on concentrations of specific hazardous substances, pollutants, and contaminants that may be found in or discharged to the environment.
- ***Location-specific ARARs*** set restrictions on certain types of activities based on site characteristics. Federal and state location-specific ARARs are restrictions placed on concentrations of a contaminant or activities to be conducted as they are in a specific location. Examples of locations that may have specific ARARs include flood plains, wetlands, historic places, and sensitive ecosystems.
- ***Action-specific ARARs*** are technology- or activity-based requirements that are triggered by the type of remedial activities under consideration. Action-specific requirements do not in themselves determine remedial alternatives, but indicate how a selected alternative must be implemented. Examples of action-specific ARARs include Resource Conservation and Recovery Act (RCRA) regulations for waste treatment, storage, and disposal.

The ARARs for this project are outlined in Table 1.

5.0 EVALUATION OF REMEDIAL ALTERNATIVES

This section identifies remedial technologies directly applicable to the Site, identifies remedial alternatives based on these technologies, and evaluates relevant information concerning the removal action alternatives that can effectively mitigate potential risks associated with VOCs in groundwater and soil gas detected at the Site. A summary and screening evaluation of technologies that may be applicable to attain the removal action objectives of the Site is also presented.

5.1 Removal Action Alternatives

Three removal action alternatives were considered for the Site. These alternatives are listed below and discussed in more detail in the following sections:

- Alternative 1: No Action
- Alternative 2: Construction of an Active Sub-Slab Depressurization System for New Buildings
- Alternative 3: Construction of a Passive Sub-Slab Depressurization System for New Buildings

5.1.1 Alternative 1: No Action

Alternative 1 is a No Action Alternative. This alternative assumes that no remedial measures will be taken at the Site and forms the basis of comparison for other alternatives.

5.1.2 Alternative 2: Construction of an Active Sub-Slab Depressurization System for New Buildings

Alternative 2 consists of constructing an active sub-slab depressurization system (SSDS) to mitigate the potential for soil gas entering the residential buildings. By preventing soil gas from entering the buildings through the floor slabs, the human health risk attributable to soil gas should be negligible.

The SSDS for Alternative 2 consists of the following components: 1) an initial gas barrier membrane placed on the soil subgrade; 2) a soil gas collection blanket (gravel blanket) beneath the floor slab and continuous interior footings; 3) inlet pipes to allow fresh air to enter the gravel blanket; 4) outlet pipes to collect fresh air from inlet pipes and soil gas and direct it to the roof; 5) a HDPE membrane constructed on top of the floor slab to mitigate the potential for gas movement into the living spaces; 6) a concrete non-structural topping slab to protect the membrane; 7) inline centrifugal fans; and 8) wind driven turbines.

The initial gas barrier will consist of a 10-mil polyethylene membrane on top of the soil subgrade (see Figure 3). The intent of the barrier is to reduce the potential for drawing soil gas into the SSDS.

The gravel blanket will be placed on the polyethylene membrane, and be retained within the footing perimeter. The gravel blanket will range from 6- to 8-inches thick. Gravel used for the gravel blanket will be gas pervious and should contain little or no fine materials (see Figure 3).

Within the gravel blanket, a series of inlet pipes will be installed at approximately 90-foot on-center spacing. The inlet pipes will lead from the roof to the gravel blanket through the building walls. The riser pipes will connect to a perforated pipe within the gravel blanket to create a broad source of outside air. The proposed locations of the inlet pipes and risers are shown on Figures 4a and 4b. Turbines on the rooftop connected to discharge outlet pipes should be located at least 25 feet from inlet pipes and at least 10 feet from other vent and building openings. At approximately the mid-point between the inlet pipes, an outlet pipe will be installed within the gravel blanket to collect and direct gases to the roof. Within the gravel blanket, the pipes will be connected to a "tee," which will be wrapped with a gas permeable geotextile to prevent gravel from entering the pipe. The riser pipes will be installed within the building walls. Typical roof penetration details are illustrated on Figures 5 and 6.

The normal slab-on-grade concrete floor slab will be placed over the gravel blanket. Utility/electrical lines, television, telephone, and plumbing installed beneath the slab will penetrate the slab at design locations. A 30-mil minimum HDPE membrane will be placed on top of the normal slab and holes will be made in the membrane at penetration locations. The holes will be repaired using pre-fabricated HDPE boots that will be slipped over the utility line, welded to the membrane, and clamped around the lines. The intent of the membrane is to minimize the potential for soil gas penetration through the floor slab. Placing a concrete, non-structure topping slab over the membrane, after penetration repairs are completed, will protect the membrane. The Project Structural Engineer should be informed of the presence of the membrane and should review details of the wall connections to verify the ability of the structural system to resist design lateral loads.

A series of inline 50 cubic feet per minute fans will be installed in the outlet pipes in the attic space or on the roofs. The fans will be connected to a sensor panel that will be centrally located to monitor fan operations. Typical fan installation details are shown on Figure 6.

The fan outlet pipes will penetrate the roof and be connected to 12-inch diameter wind-driven turbines. These turbines will serve as a backup system in case of an electrical or mechanical fan failure.

With the initial gas barrier functioning as designed, no soil gases would enter the SSDS, and the air exiting the outlet pipes from the gravel blanket would be the same as the ambient air drawn into the inlet pipes. If the initial gas barrier were to leak, the amount of soil gas passively entering the SSDS would be vastly diluted within the gravel blanket before exiting through the outlet pipes.

Prior to issuance of occupancy permits for the residential units, an indoor air-monitoring event should be performed to verify that indoor air meets the removal action objective. Indoor air sampling would be performed in accordance with the general procedures described in Appendix B and a specific sampling plan approved by DTSC. In the event that VOC concentrations exceed the removal action objective, an evaluation would be made, including discussion and input with DTSC, to assess the next steps in the indoor air quality assessment. Additional evaluation steps could include re-sampling and sampling of second floor units.

5.1.3 Alternative 3: Construction of a Passive Sub-Slab Depressurization System for New Buildings

Alternative 3 consists of constructing a passive SSDS to mitigate the potential for soil gas entering the residential buildings. The passive system differs from the active SSDS by eliminating the electrical powered fans. Like the active system (Alternative 2), the passive SSDS is intended to prevent soil gas from entering the buildings through the floor slab, and will result in negligible human health risk attributable to soil gas.

The passive SSDS consists of the following components: 1) an initial gas barrier membrane placed on the soil subgrade; 2) a continuous gravel blanket beneath the floor slab and continuous interior footings; 3) inlet pipes to allow fresh air to enter the gravel blanket; 4) outlet pipes to collect fresh air from the inlet pipes and soil gas and direct it to the roof; 5) a HDPE membrane constructed on top of the floor slab to mitigate the potential for gas movement into the living spaces; 6) a concrete topping slab to protect the membrane; and 7) wind driven turbines. All of the components of the passive system would be the same as for Alternative 2 except for the inline fans (see Section 5.1.2 for a description of the active SSDS components).

Prior to issuance of occupancy permits for the residential units, an indoor air-monitoring event should be performed to verify that indoor air meets the removal action objective. Indoor air sampling would be performed in accordance with the procedures described in Appendix B and a specific sampling plan approved by DTSC. In the event that VOC concentrations exceed the removal action objective, an evaluation would be made, including discussions and input with DTSC, to assess the next steps in the indoor air quality assessment. Additional evaluation steps could include re-sampling and sampling of second floor units. If it is concluded that the VOC source is not related to construction materials, additional measures would be implemented to convert the passive SSDS into an active SSDS as described in Section 5.1.2.

5.2 Screening Criteria

Each alternative is evaluated on the basis of three screening criteria: 1) effectiveness, 2) implementability, and 3) cost.

5.2.1 Effectiveness

This criterion examines the ability of each alternative to meet the removal action objectives when considering:

- Protection of human health;
- Compliance with ARARs;
- Long- and short-term effectiveness;
- Reduction of toxicity, mobility, or volume through treatment; and
- Future land use plans.

5.2.2 Implementability

This criterion examines the technical and administrative feasibility of implementing the removal action alternative. Evaluation includes the availability of various services and materials required during implementation of the action, and regulatory, institutional, or social concerns that could impact the action. The following factors are considered:

- Technical feasibility (ease or difficulty of implementing the alternative and reliability of the technology);
- Administrative feasibility (those activities needed to coordinate with other agencies);
- Regulatory acceptance; and
- Community acceptance.

5.2.3 Cost

This criterion evaluates the estimated capital cost, together with the estimated annual operation and maintenance cost, if appropriate. The present value of the maintenance, if applicable, is calculated at a discount rate of 7 percent.

5.3 Alternatives Evaluation

5.3.1 Alternative 1: No Action

5.3.1.1 Effectiveness

The No Action alternative is included to provide a baseline for evaluating other alternatives. For Alternative 1, no further action would be performed at the Site. Because no removal action would be implemented, overall human health risks in the near-term would remain the same if no development occurred. Because the Site will be developed for residential use, this is not a viable alternative.

5.3.1.2 Implementability

Because there is no action under this alternative, the criterion of implementability does not apply.

5.3.1.3 Cost

There is no cost associated with the No Action alternative.

5.3.2 Alternative 2: Construction of an Active Sub-Slab Depressurization System for New Buildings

5.3.2.1 Effectiveness

Alternative 2 consists of constructing an active SSDS beneath the residential buildings to remove gases that may collect under the slab-on-grade floors. The system allows fresh air to be evacuated under a negative pressure along with any soil gas. Another system component consists of a HDPE gas barrier in the slab to mitigate the potential for gas migration through the slab. This alternative would provide overall protection of human health, compliance with ARARs, long-term effectiveness and permanence, short-term effectiveness, and would accommodate future development plans for the Site. There would be no reduction in volume or toxicity of the materials since no treatment is involved.

5.3.2.2 Implementability

This technique for mitigating the potential soil gas impacts is well established, and the equipment, materials, and labor are readily available. Permits should not be required from the Bay Area Air Quality Management District (BAAQMD) as the system is not designed, nor will it be constructed, as a soil gas extraction system (BAAQMD Regulation 8, Rule 47-202). The intent of Alternative 2 is to prevent soil gas from entering the buildings through the floor slab, which will result in negligible human health risk attributable to soil gas. In addition, Regulation 2, Rule 1 lists exemptions for single and multiple family residential dwellings and an exemption for buildings that are itself not a source that requires a permit. There are no technical restrictions to implementation. There are no apparent controversies over the proposed remedy for the Site, and it is anticipated that this alternative would receive community support.

5.3.2.3 Cost

For cost estimating purposes, it is estimated that approximately 500 cubic yards (cy) of gravel, 1,200 lineal feet of pipe, 5 fans, and approximately 23,000 square feet of 30-mil HDPE and 23,000 square feet of 10-mil membrane will be required to install the system. The estimated cost of materials and installation is $45,000.

Other related costs include the electricity to power the fans and operate monitoring systems. Since the system has a relatively short life (approximately 5 years), maintenance or replacement is not expected to add significantly to the costs. As each fan draws only about 35 watts, the electrical power costs are also minimal. The present worth of the cost for electricity and maintenance for a 5-year period is estimated to be $4,000.

A verification monitoring event would be performed to confirm proper installation and operation of the system following and prior to installing the interior furnishings. Air monitoring would include the collection of ground and second level indoor air samples and an ambient sample. The estimated cost for collection, testing, and reporting of three air samples is $5,000.

The total cost for Alternative 2 is estimated to be $54,000.

5.3.3 Alternative 3: Construction of a Passive Sub-Slab Depressurization System for New Buildings

5.3.3.1 Effectiveness

Alternative 3 will consist of the same equipment as Alternative 2, except that the inline fans are eliminated. As required in Alternative 2, a monitoring event would be necessary to verify proper installation of the system and functioning to meet the removal action objective. This alternative would provide overall protection of human health, compliance with ARARs, long-term effectiveness and permanence, short-term effectiveness, and would accommodate future development plans for the Site. There would be no reduction in volume or toxicity of the materials since no treatment is involved

5.3.3.2 Implementability

This technique for mitigating the potential soil gas impacts is well established, and the equipment, materials, and labor are readily available. A BAAQMD Permit will not be required since this is a passive system (and for the same reasons presented for Alternative 2). There are no technical restrictions to implementation. There are no apparent controversies over the proposed remedy for the Site. Passive systems are in place throughout California, and additional DTSC approved systems are currently being constructed throughout the state under similar circumstances. It is not known if the community would favor Alternative 3 over Alternative 2.

5.3.3.3 Cost

For cost estimating purposes, it is estimated that approximately 500 cy of gravel, 1,200 lineal feet of pipe, approximately 23,000 square feet of 30-mil HDPE and 23,000 square feet of 10-mil membrane will be required to install the system. The estimated cost of materials and installation is $43,000.

A verification monitoring event would be performed to confirm proper installation and operation of the system following and prior to installing the interior furnishings. Air monitoring would include the collection of ground and second level indoor air samples and an ambient sample. The estimated cost for collection, testing, and reporting of three air samples is $5,000. Since the system has no moving parts (other than the wind turbines), potential costs associated with maintenance or replacement is expected to be negligible.

The total cost for Alternative 3 is estimated to be $48,000.

6.0 COMPARATIVE ANALYSIS OF REMEDIAL ACTION ALTERNATIVES

A comparison of the removal action alternatives is presented in Table 2. Alternative 1 (No Action) would not meet the removal action objective; therefore, this alternative will not be considered further in this comparison. Details of the comparative evaluation are provided below.

6.1 Effectiveness

Alternatives 2 and 3 would both meet the removal action objective of protecting public health from known contaminants in soil gas at the Site by effectively removing the pathway for human contact. Alternatives 2 and 3 both remove fresh air and potentially soil gas from beneath the floor slabs with the use of wind-driven turbines. Alternative 2 adds in-line fans to supplement the wind-driven turbines. The combination of the 30-mil HDPE membrane and ability of the systems to exchange air from beneath the slab make both Alternatives 2 and 3 effective. Alternative 3 has added inherent reliability in that it has no moving parts other than the wind-driven turbines.

6.2 Implementability

There are no administrative or technical requirements precluding implementation for either Alternatives 2 or 3. Both alternatives involve the same features and equipment, except inline fans are supplemented for Alternative 2. Both alternatives can be constructed within an approximate 2- to 3-week time frame

6.3 Cost

Alternative 2 is estimated to cost approximately $54,000. The estimated cost for Alternative 3 is approximately $48,000.

6.4 Public Acceptance

Alternatives 2 and 3 would allow use of the Site for the much-needed affordable housing prior to completion of the final remedy for the VOC-impacted groundwater. It is anticipated that the public will support either alternative that would allow the construction to proceed and be protective of human health. Alternatives 2 and 3 are both capable of meeting the indoor air remedial action objective.

Alternative 2 may be perceived as providing a slightly higher level of certainty since as incorporates an active gas removal system. However, mechanical systems are subject to mechanical or electrical failure and require monitoring and maintenance. A passive system does not require maintenance. Although the power needs are low, Alternative 2 uses electricity to power the fans.

7.0 RECOMMENDED REMOVAL ACTION ALTERNATIVE

Alternative 3 is the recommended removal action alternative for the Site. This alternative is selected based on its ability to meet the removal action objectives, cost, protectiveness provided by the passive SSDS, and the nature of the system to eliminate the effects of mechanical and electrical breakdown and need for continuous monitoring and maintenance. This alternative is protective of human health and the environment, and complies with existing regulatory cleanup criteria, while allowing full use of the Site for the intended development.

Following approval of the RAW, implementation of the removal action work can be performed at the time of construction with little impact to the project schedule. The work will be performed in accordance with the procedures outlined in the RAW. The work will additionally be governed by a site-specific health and safety plan, if appropriate, and an existing DTSC approved *Site Management Plan* (ERM, 2002). All work will be conducted under the oversight of DTSC.

A Removal Action Implementation Report will be submitted within one month following completion of the removal action.

8.0 REMOVAL ACTION IMPLEMENTATION

8.1 Purpose

The purpose of implementing removal action at the Site is to protect human health by minimizing exposure to potentially VOC-impacted soil gas in indoor air within the proposed 39-Unit Apartments. The intent of the SSDS is to eliminate the potential pathway for residents to contact soil gas. This would be accomplished by the installation of gas barriers, use of a gas permeable layer, vent and outlet piping, wind turbines, and roof venting.

8.2 Scope of Work

As presently planned, the development of the Site will include 39-units of affordable housing. The apartment complex will consist of three 2-story wood-frame buildings that surround a court-yard with a separate teen recreation facility in the courtyard. The buildings will be supported on a shallow foundation system with a concrete slab-on-grade, and will be surrounded by landscape areas and paved parking. The recommended removal action (Alternative 3) will consist of placing an initial gas barrier, a gas permeable gravel layer, inlet and outlet pipes, a HDPE gas barrier membrane on the slab-on-grade, constructing a topping slab, and installing wind turbines.

8.2.1 Initial Gas Barriers

Prior to installation of the initial gas barrier, site grading activities will commence with clearing and grubbing to remove vegetation from the Site. Significant vegetation is not currently present; if vegetation is present at the time of construction, it will be removed. Existing soil stockpiles will also be removed. The subgrade will be scarified, moisture conditioned, and recompacted. Within the limits of the perimeter foundation, a 10-mil polyethylene membrane will be placed on the compacted subgrade. The membrane should be overlapped and any joints, if present, taped. This membrane is intended to reduce the potential for soil gas to enter the SSDS from beneath the building and eliminate the need for air permitting. Care should be taken to eliminate punctures of this membrane during slab-on-grade construction. It is anticipated that DTSC and the system designer will provide oversight of the system construction.

8.2.2 Gravel Blanket

After placing the concrete footing, the gravel blanket will be installed over the polyethylene membrane. Gravel will be poured or dumped in place and spread. The gravel blanket will be retained within the building perimeter and range from 6- to 8-inches thick.

The gravel will be an open graded subrounded rock meeting the following specifications:

Sieve Size	Percentage Passing
1”	100
¾”	90 to 100
No. 4	0 to 10
No. 10	0 to 1

8.2.3 Piping

A series of inlet pipes will be installed at approximate 90-foot on-center spacing within the gravel blanket. The inlet pipes will lead from the roof within walls to the gravel blanket (riser). The pipes will be 2-inch diameter Schedule 40 PVC. The riser will connect to a horizontal lateral with factory cut 0.080-inch slots, or equivalent.

At approximately the midpoints between the inlet pipes, an outlet (suction) pipe will be installed within the gravel layer to collect and direct gases to the roof. Within the gravel blanket, the pipes will be connected to a “tee” and lateral perforated pipes will extend from the tee to the perimeter footings. The pipes will be wrapped with a gas permeable geotextile, (Marafi 140N or equivalent) to prevent gravel from entering the pipe. The outlet pipe will be a 3-inch diameter Schedule 40 PVC pipe. Pipes above the slabs should be supported every 5 feet and anchored at least every 10 feet, as appropriate.

Inlet pipes should be located a minimum of 25 feet from outlet pipes and 10 feet from other vent and building openings.

8.2.4 Gas Barrier Membrane

The slab-on-grade concrete floor slab will be placed over the gravel blanket. Utility/electrical lines, television, telephone, and plumbing installed beneath the slab will penetrate the slab at design locations. A 30-mil minimum HDPE membrane will be placed on top of the slab and holes will be made in the membrane at penetration locations. The holes will be repaired to make them gas tight by using prefabricated HDPE boots slipped over the utility line, welded to the membrane, and clamped around the lines. All welds and seams should be leak tested in accordance with the manufacturer’s specifications. The membrane should be inspected prior to placing the protective concrete topping slab to verify integrity. If any holes or damage are found, the membrane should be repaired and re-tested. The Project Structural Engineer should be informed on the presence of the membrane and should review the details of the wall connections to verify the ability of the structural system’s ability to resist lateral design loads.

8.2.5 Topping Slab

After the membrane has been inspected and found to be satisfactory, a 2-inch thick non-structural topping slab will be placed over the membrane for protection from damage. In addition, the topping slab will serve as a protective layer and heat conductive slab for the proposed hydronic heating system. If penetrations are made through the topping slab and membrane to create hold-downs (or for other purposes), appropriate measures should be taken to minimize the potential for leaks at these locations.

8.2.6 Wind Turbines

The outlet lines will connect to wind turbines on the roof. The turbines will be 12-inches in diameter and located a minimum of 25 feet from inlet pipes and 10 feet from other vents or building openings.

8.2.7 Health and Safety Monitoring

As indicated in the DTSC approved *Site Management Plan* (ERM, 2002), IR02 has been remediated to remove PCBs and cadmium, and health risk assessments have determined that risks associated with a residential exposure scenario are within the designated risk management range. In accordance with the *Site Management Plan*, an assessment will be made to evaluate if workers must meet the training requirements of Occupational Safety and Hazards Administration (OSHA) 29CFR 1910.120. If OSHA-trained workers are required due to the environmental conditions or proposed depths of excavation, a Site-Specific Health and Safety Plan will be prepared for review by DTSC. Health and safety measures, if required, would likely include the use of personal protective equipment (PPE), air monitoring for VOCs and dust, and worker decontamination measures.

8.2.8 Implementation Report

A report summarizing the implementation of removal actions at the Site will be submitted to the DTSC within 1 month following completion of the remedial activities.

8.2.9 Project Schedule

The portion of the project involving implementation of removal actions in and below the slab-on-grade is expected to take 2 to 3 weeks to complete, including covering the membrane with the concrete topping slab. Installation of the riser piping, roof penetrations, and wind turbine installation will occur later in the construction schedule.

9.0 REFERENCES

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TABLES

TABLE 1
Potential Chemical-Specific ARARs

Standard, Requirement, Criteria, Limitation	Citation	Description	ARAR Determination	Comments
FEDERAL ARARs				
National Ambient Air Quality Standards	42 USC 7409 40 CFR Part 50	Ambient air quality standards for specified criteria air pollutants.	Not ARAR	Emissions of criteria pollutants are not expected to exceed threshold levels.
RCRA Hazardous Waste Identification	40CFR Part 261 Subpart C	Establishes whether solid waste exhibits characteristic of toxicity, ignitability, corrosivity, or reactivity or are listed hazardous wastes	Not ARAR	Excavated soil and extracted soil gas are not expected to exhibit hazardous waste characteristics.
STATE ARARs				
Air Resources Act	Cal HSC, Div 26, Section 39000 17CCR Part III, Chapter 1, Section 6000	Establishes state ambient air quality standards; Regulates vehicular and nonvehicular sources of air contaminants.	Not ARAR	Emissions of criteria pollutants are not expected to exceed threshold levels.
California Hazardous Waste Control Law	Cal HSC, Division 20, Chap 6.5	Establishes standards for management of hazardous wastes	Not ARAR	Wastes generated during remediation are not expected to exceed state criteria.

TABLE 1
Potential Action-Specific ARARs

Standard, Requirement, Criteria, Limitation	Citation	Description	ARAR Determination	Comments
FEDERAL ARARs				
RCRA hazardous waste generator standards	40 CFR Parts 262 & 265	Generator standards, including waste identification, manifesting; packaging, labeling, accumulation time, record keeping, reporting, preparedness and prevention, contingency plans, training, emission from process vents.	Not ARAR	Remedial activities are not expected to generate RCRA hazardous waste.
RCRA land disposal restrictions	40 CFR Part 268.7	Requirements for identification of restricted hazardous wastes prior to offsite disposal.	Not ARAR	No RCRA hazardous waste is expected to be disposed offsite.
DOT requirements for hazardous material transport	49 CFR Parts 171-177	Standards for transportation of hazardous materials.	Not ARAR	No hazardous materials are expected to be transported offsite.
OSHA Hazardous Waste Operations and Emergency Response Regulations	29 CFR 1910.120	Standards for employee safety during specified hazardous waste and emergency response operations.	Potentially applicable	Site has been designated for cleanup by government agency.

TABLE 1
Potential Action-Specific ARARs

Standard, Requirement, Criteria, Limitation	Citation	Description	ARAR Determination	Comments
STATE ARARs				
Hazardous waste generator standards	22 CCR Division 4.5	Generator standards, including waste identification, manifesting; packaging, labeling, accumulation time, record keeping, reporting, preparedness & prevention, contingency plans, training	Not Applicable	No California hazardous wastes expected to be generated at the Site.
BAAQMD General Provisions – Nuisance	Regulation 1, Rule 1-301	Prohibits discharge of air contaminants that cause injury, nuisance or annoyance.	Applicable	Proposed construction activities and soil gas discharge will be managed to avoid nuisance conditions.
BAAQMD Permits	Regulation 2, Rule 1-113	Requires new sources to obtain permits if emissions exceed specified thresholds.	Not applicable	Single and multiple family dwellings used solely for residential purposes are exempt from permitting
BAAQMD Performance Requirements for Air Stripping and Soil Vapor Extraction Operations	Regulation 8, Rule 47	Defines soil vapor extraction and specifies permitting and performance requirements.	Not applicable	Proposed sub-slab depressurization system does not meet definition of soil vapor extraction system because it includes ventilation and membrane components that significantly limit vapor migration from soil.

TABLE 1
Potential Location-Specific ARARs

Standard, Requirement, Criteria, Limitation	Citation	Description	ARAR Determination	Comments
FEDERAL ARARs				
Location Design Standards	40 CFR 264.18(a)	Establishes standards for construction of treatment, storage or disposal facilities for hazardous waste.	Not Applicable	No RCRA hazardous waste facility will be constructed or operated at Site.
STATE ARARs				
Location Design Standards	Title 22 CCR Section 66264.18(a)	Establishes standards for construction of treatment, storage or disposal facilities for hazardous waste.	Not Applicable	No California hazardous waste facility will be constructed or operated at Site.

TABLE 1
To Be Considered Criteria

Standard, Requirement, Criteria, Limitation	Citation	Description	ARAR Determination	Comments
None				

Note:
ARARs: Applicable or Relevant and Appropriate Requirement

TABLE 2
Comparison of Removal Action Alternatives

Cost	Alternative 1 No Action $0	Alternative 2 Active SSDS $49,000	Alternative 3 Passive SSDS $51,000
Effectiveness			
Overall Protection of Human Health & the Environment	No	Yes	Yes
Compliance with ARARs	No	Yes	Yes
Long-Term Effectiveness and Permanence	No	Yes	Yes
Reduction in Toxicity, Mobility, and Volume	No	No	No
Short-Term Effectiveness	Yes	Yes	Yes
Technical Feasibility	Yes	Yes	Yes
Implementability			
Technical Feasibility	Yes	Yes	Yes
Administrative Feasibility	Yes	Yes	Yes
State Acceptance	No	No	Yes
Accommodation of Redevelopment	No	No	No
Community Acceptance	No	Yes	TBD

FIGURES

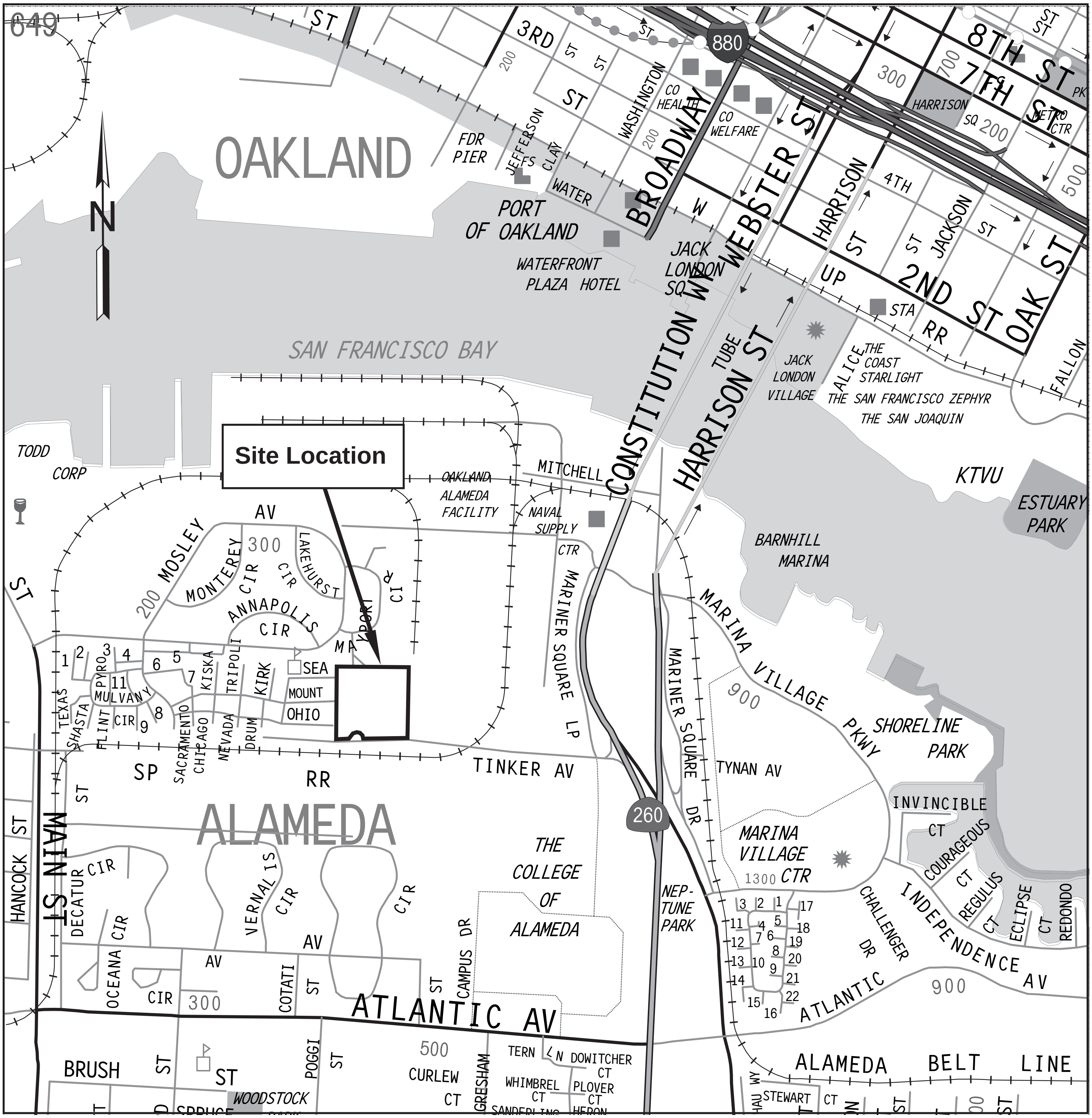


Figure 1
Site Location Map

northgate environmental management, inc

39-Unit Apartments
Alameda, California
September 2006
Proj. No. 1127.01

Basemap: Thomas Bros. Maps ,1999

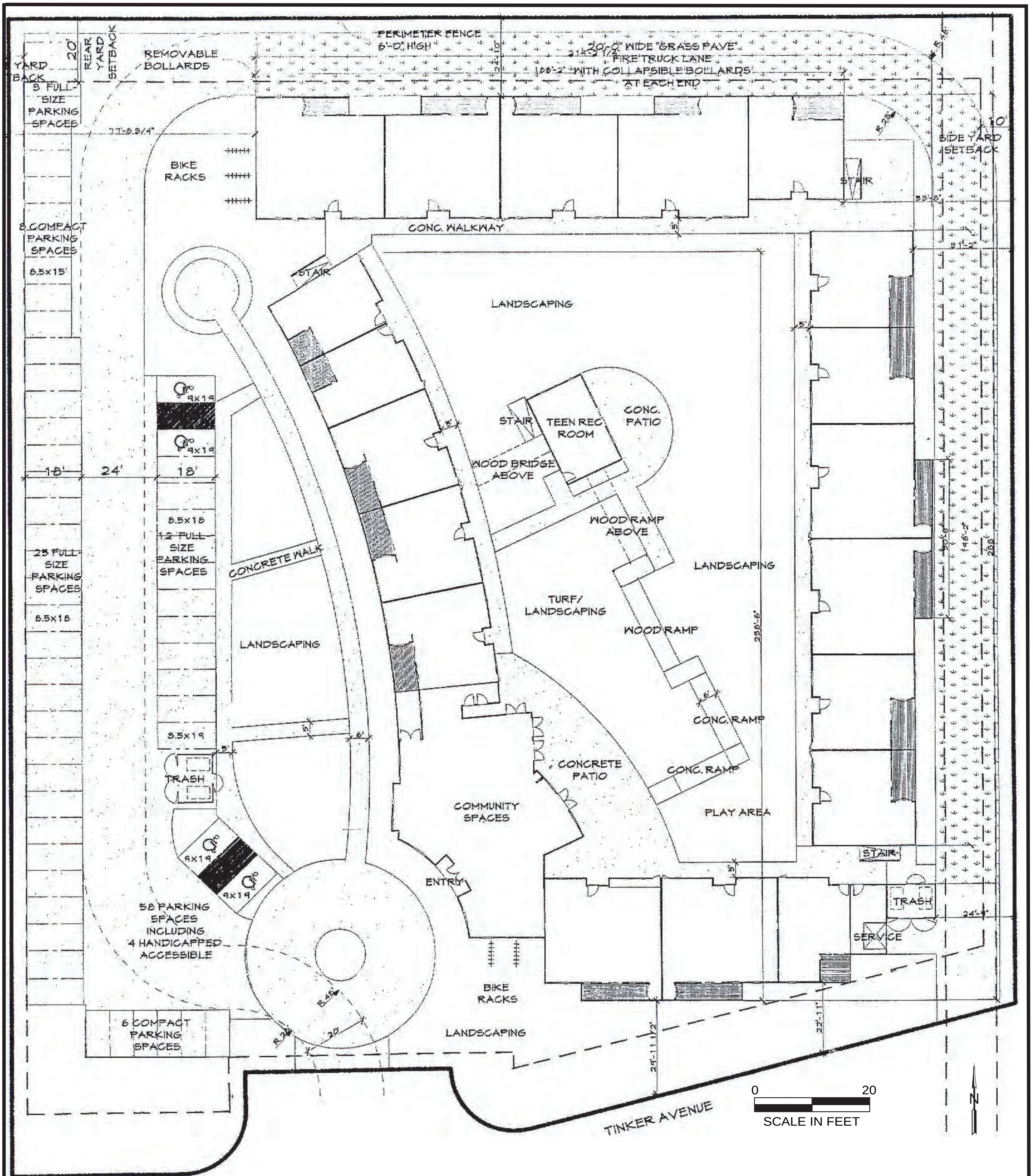
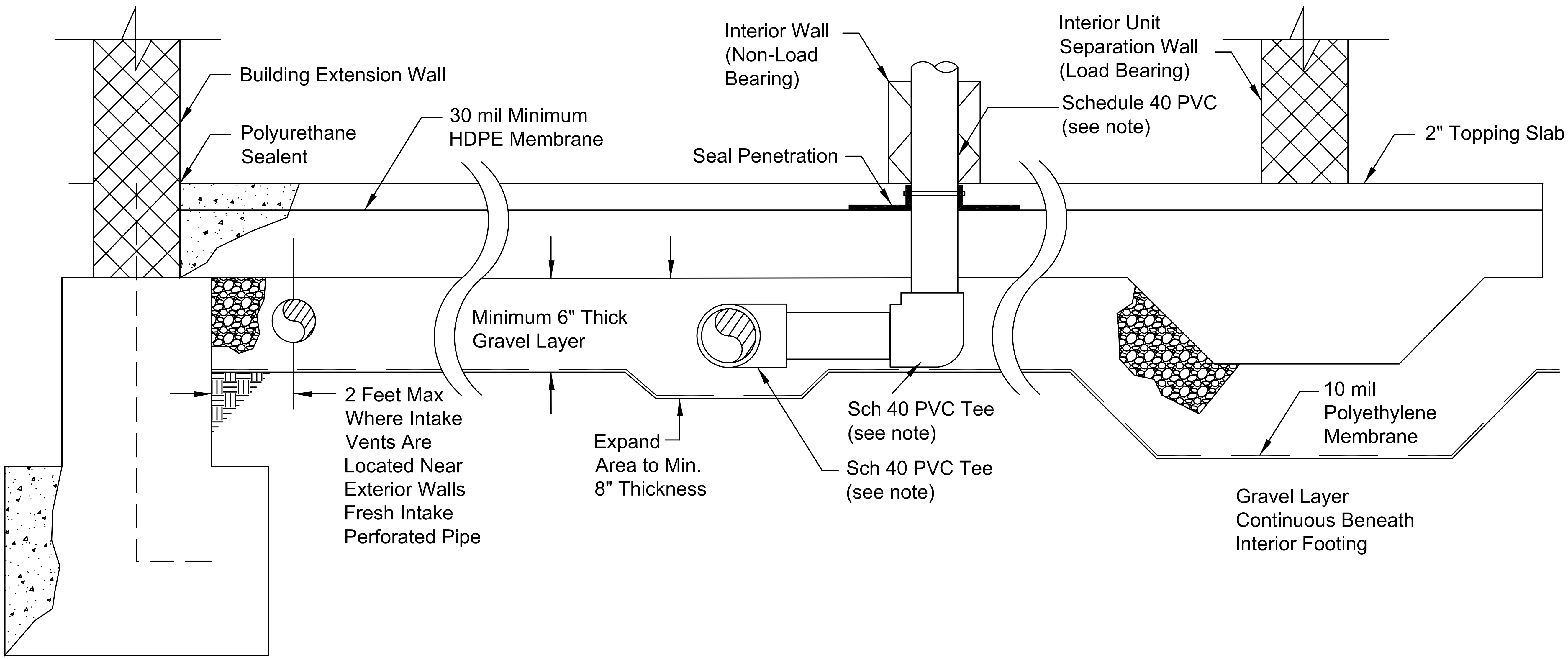


Figure 2
Site Plan

northgate environmental management, inc

39-Unit Apartments
Alameda, California
September 2006
Proj. No. 1127.01

Basemap: Mikiten, 2004



Note:
- Gravel layer shall be continuous beneath entire slab.
- Use 3"Ø PVC pipe & fittings for outlet lines.
- Use 2"Ø PVC pipe & fittings for intake lines.
- All penetrations through slab shall be sealed w/ HDPE boots.
- For horizontal air intake lines use factory slotted 2"Ø PVC 40 casing w/ 0.080" slots

Note:
Locate Exhaust Stack Minimum 10 Feet from other Vents and Building Openings

NOT TO SCALE

FIGURE 3
Typical Slab and Piping Details

39-Unit Apartments
Alameda, California
September 2006
Project No. 1127.01

northgate environmental management, inc.

Explanation

Fresh Air Inlet
Slotted Lateral
Beneath Slab

Typical Riser

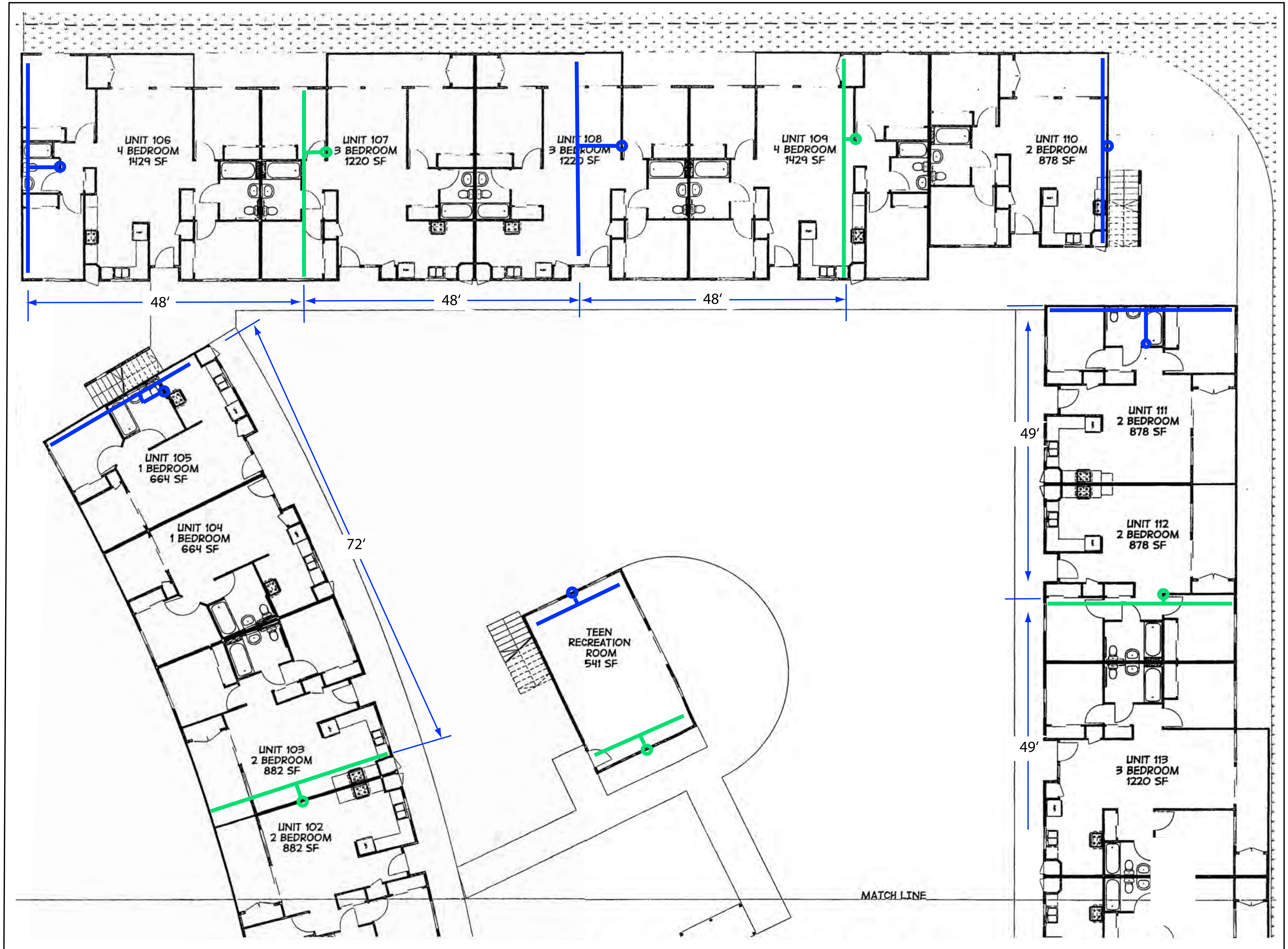
Outlet Pipe
and Riser

FIGURE 4a
Sub-Slab Depressurization Layout

Ground Floor Plan (South)
1/8" =1'-0"

39-Unit Apartments
Alameda, California
September 2006
Project No. 1127.01

northgate environmental management, inc



Explanation

Fresh Air Inlet
Slotted Lateral
Beneath Slab

Typical Riser

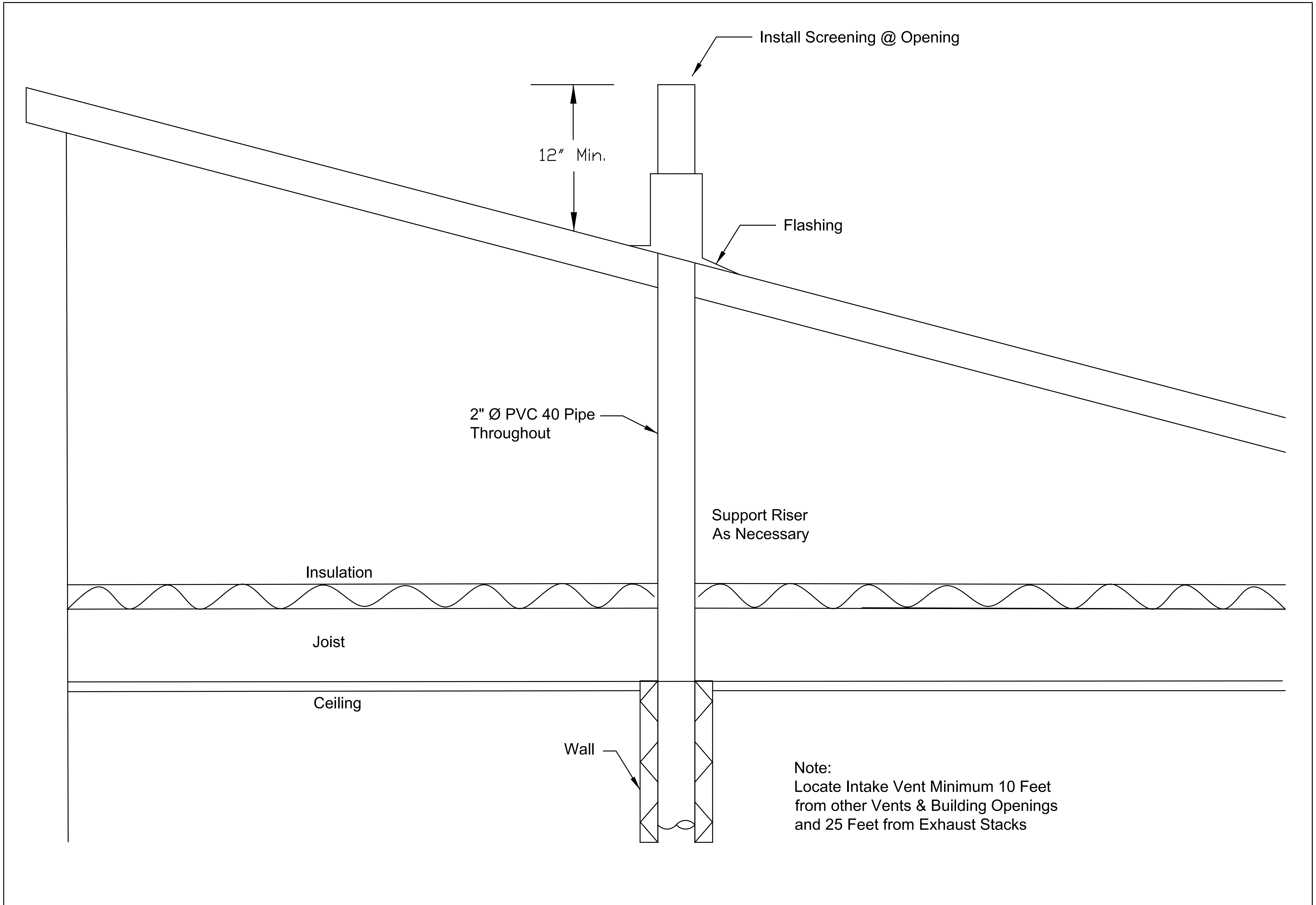
Outlet Pipe
and Riser

FIGURE 4b
Sub-Slab Depressurization Layout

Ground Floor Plan (North)
1/8" =1'-0"

39-Unit Apartments
Alameda, California
September 2006
Project No. 1127.01

northgate environmental management, inc

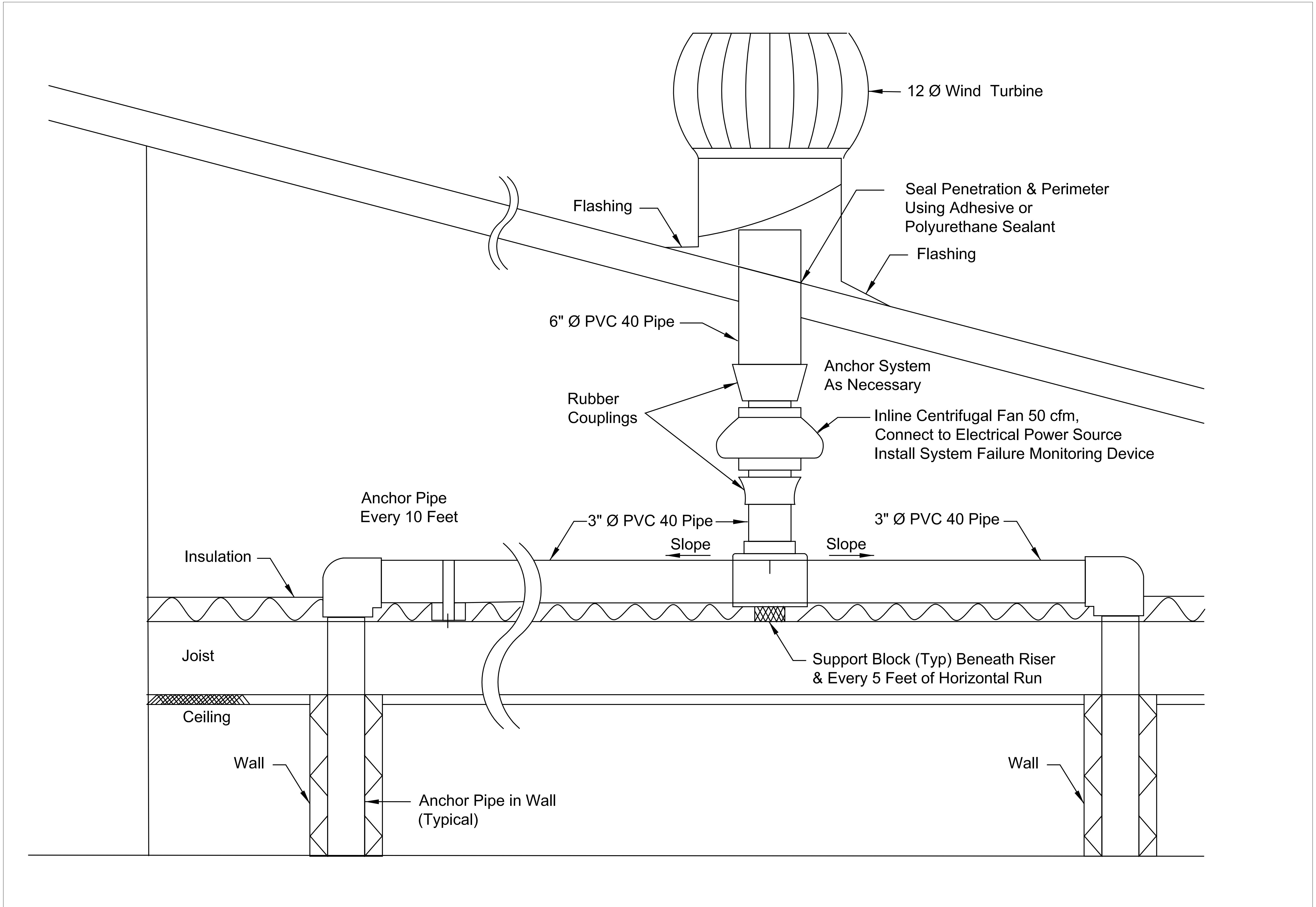


NOT TO SCALE

FIGURE 5
Typical Roof Penetration for Single Intake Vent

39-Unit Apartments
Alameda, California
September 2006
Project No. 1127.01

northgate environmental management, inc.



Note:
Locate Exhaust Stack Minimum 10 Feet from other Vents and Building Openings

NOT TO SCALE

FIGURE 6
Typical Roof Penetration for Multiple Outlet Pipes

39-Unit Apartments
Alameda, California
September 2006
Project No. 1127.01

northgate environmental management, inc.

APPENDIX A
LEGAL DESCRIPTION

EXHIBIT "A"
LEGAL DESCRIPTION
39 UNIT PARCEL

All that certain real property situate in the City of Alameda, County of Alameda, State of California, described as follows:

A portion of the REMAINDER PARCEL, as said parcel is shown on that certain map entitled "TRACT 7511 – BAYPORT", filed for record on July 9, 2004 in Book 277 of Maps at Pages 1 through 19 inclusive, Alameda County Records, more particularly described as follows:

BEGINNING at the intersection of northerly right-of way line of Tinker Avenue, a varying width right-of-way, and the westerly line of said REMAINDER PARCEL, as shown on said map;

Thence along said westerly line, North 02°47'17" East 367.75 feet to the northerly line of said parcel;

Thence leaving said westerly line and along said northerly line, South 87°12'43" East 319.50 feet;

Thence leaving said northerly line, South 02°47'17" 313.77 feet to the northerly right-of-way line of said Tinker Avenue as shown on said map;

Thence along said northerly right-of-way the following eleven (11) courses:

1. South 78°16'48" West 15.83 feet;
2. South 89°35'24" West 50.99 feet;
3. South 78°16'48" West 50.00 feet;
4. South 68°12'46" West 45.86 feet to the beginning of a curve to the right, having a radius of 23.00 feet;
5. Along said curve, through central angle of 103°36'07", an arc length of 41.59 feet;
6. North 87°55'20" West 10.37 feet;
7. South 72°47'56" West 29.66 feet;
8. North 87°55'20" West 10.46 feet to the beginning of a non-tangent curve to the left, having a radius of 25.00 feet, to which point a radial line bears South 76°51'22" East;

9. Along said curve, through a central angle of 76°47'02", an arc length of 33.50 feet to a point of compound curvature, said curve having a radius of 690.00 feet;
10. Along said curve, through a central angle of 2°06'52", an arc length of 25.46 feet;
11. North 87°57'28" West 33.50 feet to the **POINT OF BEGINNING**.

Containing an area of 109,163 square feet or 2.51 Acres, more or less.

A plat showing the above-described parcel is attached herein and made a part hereof as Exhibit "B".

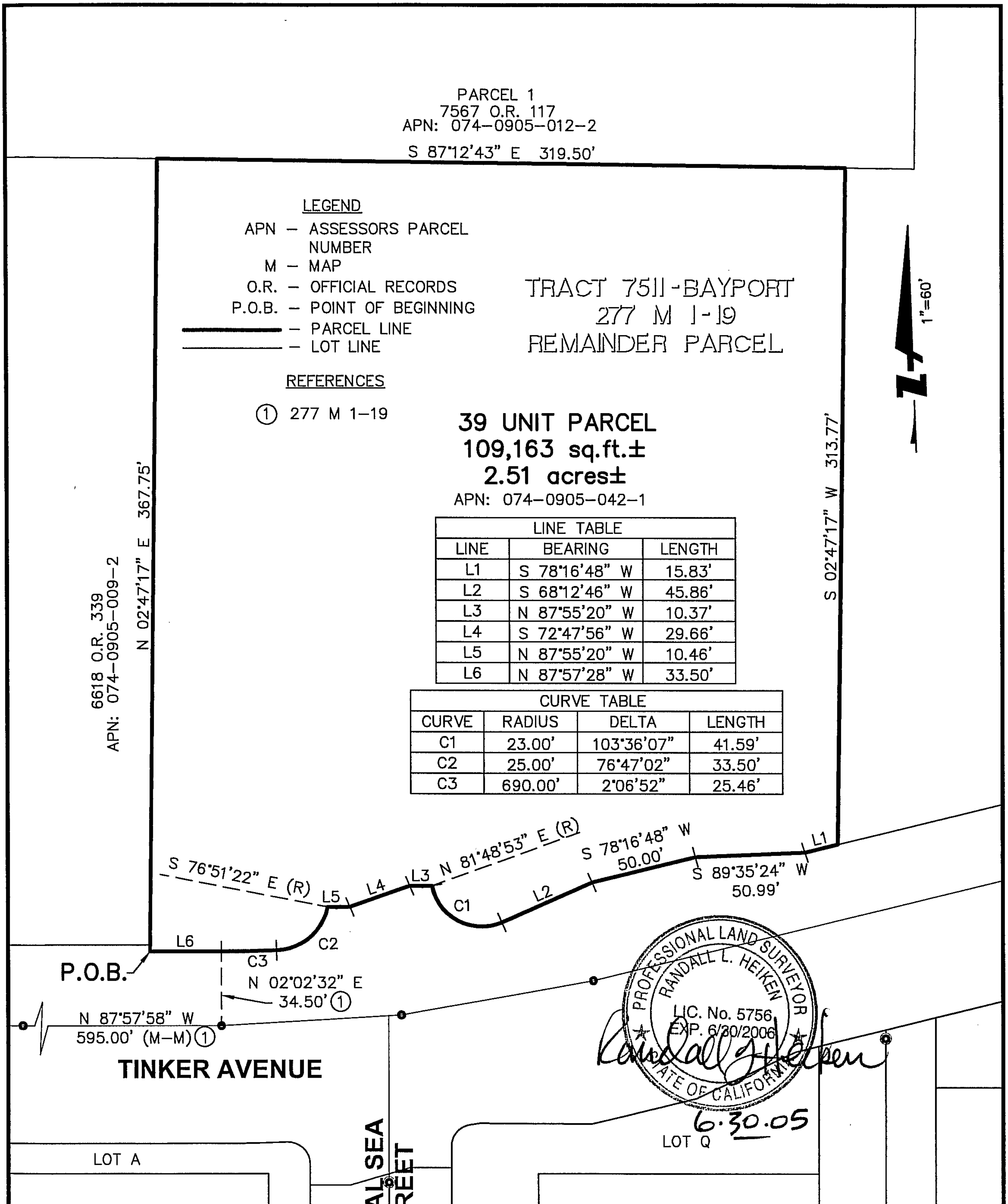
This description was prepared by me or under my direction in conformance with the Professional Land Surveyors Act.

PROFESSIONAL LAND SURVEYOR
RANDALL L. HEIKEN
LIC. No. 5756
EXP. 6/30/2006
STATE OF CALIFORNIA

6.30.05

Randall L. Heiken, P.L.S. 5756
License Expires: 6-30-2006
K:\Main\1998\980221\Legals\39unit.DOC

Dated:



LINE TABLE		
LINE	BEARING	LENGTH
L1	S 78°16'48" W	15.83'
L2	S 68°12'46" W	45.86'
L3	N 87°55'20" W	10.37'
L4	S 72°47'56" W	29.66'
L5	N 87°55'20" W	10.46'
L6	N 87°57'28" W	33.50'

CURVE TABLE			
CURVE	RADIUS	DELTA	LENGTH
C1	23.00'	103°36'07"	41.59'
C2	25.00'	76°47'02"	33.50'
C3	690.00'	2°06'52"	25.46'

BKF

ENGINEERS / SURVEYORS / PLANNERS

4780 CHABOT DR., SUITE 104
PLEASANTON, CA 94588
925/396-7700 (TEL)
925/396-7799 (FAX)

EXHIBIT "B"
39 UNIT PARCEL

Drawn: RL	Checked: WS	Approved: RLH
Job No.: 980221-18	Date: 06/28/05	Sheet: 1 of 1

K:\Sur98\980221\DWG\PLATS\39unit.dwg 6/29/2005 2:51:17 PM PDT

```
Parcel name: FEE_39UNIT

   North: 472796.9492          East : 1484718.0359
Line   Course: N 02-47-17 E  Length: 367.75
         North: 473164.2639            East : 1484735.9239
Line   Course: S 87-12-43 E  Length: 319.50
         North: 473148.7229            East : 1485055.0457
Line   Course: S 02-47-17 W  Length: 313.77
         North: 472835.3243            East : 1485039.7834
Line   Course: S 78-16-48 W  Length: 15.83
         North: 472832.1088            East : 1485024.2834
Line   Course: S 89-35-24 W  Length: 50.99
         North: 472831.7439            East : 1484973.2947
Line   Course: S 78-16-48 W  Length: 50.00
         North: 472821.5874            East : 1484924.3371
Line   Course: S 68-12-46 W  Length: 45.86
         North: 472804.5660            East : 1484881.7530
Curve   Length: 41.59                 Radius: 23.00
         Delta: 103-36-07            Tangent: 29.23
         Chord: 36.15                 Course: N 59-59-11 W
     Course In: N 21-47-14 W      Course Out: S 81-48-53 W
     RP  North: 472825.9231            East : 1484873.2163
     End North: 472822.6485            East : 1484850.4506
Line   Course: N 87-55-20 W  Length: 10.37
         North: 472823.0244            East : 1484840.0874
Line   Course: S 72-47-56 W  Length: 29.66
         North: 472814.2532            East : 1484811.7540
Line   Course: N 87-55-20 W  Length: 10.46
         North: 472814.6324            East : 1484801.3009
Curve   Length: 33.50                 Radius: 25.00
         Delta: 76-47-02             Tangent: 19.81
         Chord: 31.05                 Course: S 51-32-09 W
     Course In: N 76-51-22 W      Course Out: S 00-04-20 E
     RP  North: 472820.3174            East : 1484776.9559
     End North: 472795.3174            East : 1484776.9874
Curve   Length: 25.46                 Radius: 690.00
         Delta: 2-06-52              Tangent: 12.73
         Chord: 25.46                 Course: N 89-00-54 W
     Course In: N 00-04-20 W      Course Out: S 02-02-32 W
     RP  North: 473485.3168            East : 1484776.1176
     End North: 472795.7551            East : 1484751.5288
Line   Course: N 87-57-28 W  Length: 33.50
         North: 472796.9489            East : 1484718.0501

   Perimeter: 1348.26   Area: 109,162.50 sq.ft. 2.51 acres

Mapcheck Closure - (Uses listed courses, radii, and deltas)
Error Closure: 0.0141              Course: S 88-55-05 E
  Error North: -0.00027            East : 0.01414
Precision  1: 95,619.86
```

PROFESSIONAL LAND SURVEYOR
RANDALL L. HEIKEN
LIC. No. 5756
EXP. 6/30/2006
STATE OF CALIFORNIA

Randall L. Heiken

6.30.05

APPENDIX B
INDOOR AIR MONITORING PROCEDURES
AND QUALITY ASSURANCE

APPENDIX B
INDOOR AIR MONITORING PROCEDURES AND QUALITY ASSURANCE

Indoor air sampling is proposed in the completed 39-Unit Apartments. The purpose of sampling is to verify that indoor air meets the Project Removal Action Objective and is therefore protective of human health.

SAMPLING

Sampling will be performed following completion of the building enclosure, and if possible, prior to the installation of products that potentially off-gas volatile organic compounds (VOCs). In the case of the active system alternative, the system would be operated a minimum of 1 week before collecting indoor air samples. Similarly, the heating and ventilating system should not be operated for 1 week prior to collecting the indoor air samples for both the active and passive system alternatives.

It is proposed to collect three samples. The exact locations will be selected at the time of sampling with concurrence from the Department of Toxic Substances Control (DTSC). The intent of selecting sampling locations will be that locations are representative of the indoor air within the ground floor residential units and the second level units. In addition, one ambient air sample will be collected outside the units from an up-wind location.

Indoor air samples will be collect in evacuated 6-liter certified polished Summa canisters. The gauge pressure of the canisters will be checked to verify a minimum of negative 29 inches of mercury prior to use of the canister. A flow controller would be attached to the canister valve and a leak check performed. The sample will be collected over a 24-hour period, and pressure in the canister should be approximately zero. If negative pressure remains, the canister will be opened again until a reading of approximately zero in attained. Samples will be collected at a height of 3 feet above the floor.

Appropriate field condition and sampling documentation, labeling, and chain-of-custody procedures will be followed. There are no special sample preservation methods for the soil gas samples. The holding time for EPA TO-15 samples is 30 days. One trip blank and one field duplicate will be collected for laboratory testing.

LABORATORY TESTING

The indoor air and ambient samples will be tested using EPA Method TO-15. The reported analytes will be benzene and naphthalene. Samples will be transported for testing to Air Toxics Ltd. of Folsom, California. Standard laboratory quality control and quality assurance (QA/QC) procedures will be followed including laboratory duplicates, spikes, and equipment calibration. Air Toxics Ltd. has indicated their normal reporting limit for the TO-15 method for benzene as 0.32 $\mu g/m^3$ and for naphthalene is 2.6 $\mu g/m^3$. Depending on the instrument condition at the time of testing, and testing a sample free of matrix interference, the laboratory may achieve a reporting limit as low as 0.16 $\mu g/m^3$ and XX $\mu g/m^3$ for naphthalene. The laboratory has indicated that the ubiquitous presence of benzene in the environment is often a concern at these low levels of detection.

EVALUATION OF DATA

The results of the laboratory testing of indoor and ambient air samples will be reviewed by Northgate and DTSC to verify that the passive system is functioning as designed and is protective of human health.